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Engineering Library

THE MUNICIPAL UNIVERSITY *of* AKRON

Akron, Ohio *May, 1923*

COLLEGE OF ENGINEERING AND COMMERCE

Co-operative Plan

THE LIBRARY OF THE UNIVERSITY OF ILLINOIS

ANNOUNCEMENT FOR

1923-1924

PUBLISHED BY
THE MUNICIPAL UNIVERSITY OF AKRON

COLLEGE OF ENGINEERING AND COMMERCE

Co-operative Plan

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CALENDAR

1923

September 17, Monday	Registration and classification, engineers and freshmen in Commerce—Section I.
September 17 and 18	Registration and classification, Commerce, (sophomores, juniors, and seniors).
September 18, Tuesday	Class work begins for engineers and freshmen in Commerce —Section I.
September 19, Wednesday	Class work begins for Commerce (sophomores, juniors, and seniors).
October 1, Monday	Registration and classification, engineers and freshmen in Commerce—Section II.
October 2, Tuesday	Class work begins for engineers and freshmen in Commerce —Section II.
November 29, 30, and December 1, Thursday, Friday and Saturday	Thanksgiving Recess.
December 21, Friday, 5:00 P. M.	Christmas vacation begins.

1924

January 7, Monday	Class work resumed.
January 18, Friday	Founder's Day.
January 25 and 26	Registration and classification for Commerce (sophomores, juniors, and seniors).
February 18, Monday	Registration for engineers and freshmen in Commerce, Section I.

February 22, Friday	Washington's Birthday — a holiday.
March 3, Monday	Registration for engineers and freshmen in Commerce, Section II.
April 12, Saturday noon	Easter recess begins.
April 21, Monday	Class work resumed.
May 15, Thursday	Student elections.
May 23, Friday	Tree Day.
June 15, Sunday	Baccalaureate Exercises.
June 16-18, Monday to Wednesday inclusive	Commencement.

COLLEGE OF ENGINEERING AND COMMERCE

FRED. E. AYER, C. E., DEAN

GENERAL INFORMATION

The Directors of the Municipal University of Akron established the College of Engineering in 1914, and adopted the five-year co-operative course patterned after the "Cincinnati Plan".

In 1921 the Department of Commerce and Administration became a department of the Engineering College and the name of the latter was changed to the College of Engineering and Commerce. Beginning with the fall of 1923, the commerce and administration courses will be operated on the co-operative basis. Students already enrolled will continue on full time.

The "Cincinnati Plan" aims to give the student a thorough training in both theory and practice by requiring the practice to be learned under actual commercial conditions in local industrial organizations, and the underlying science to be studied in the University under trained educators. To accomplish this the students are grouped in two sections, one of which is at work and the other in attendance at the University. For example, A, who is in section one, attends classes at the University for two weeks while B, who is paired with A, and who is in section two, is at work. Then they change places, and B attends the University for two weeks while A is at work. Of course this necessitates the giving of all University work twice, once for each section.

Five years of eleven months each are required to complete the course, each student being allowed a vacation of one week at Christmas time, one week at Easter or during commencement week, and two weeks in the latter part of the summer.

Candidates for admission are expected to spend the summer, preceding their entrance, at continuous work on a job provided by the University. This probationary period affords the student an opportunity to test his fitness and liking for the course, and demonstrates his ability to satisfy his employer. Candidates who have definitely decided to take the course and who can present satisfactory evidence of their ability to do the outside work may be excused during the probationary period. But in order to provide a job for each entering student, it is necessary that applications be received prior to July first. Students applying after that date will not be accepted unless there are vacancies due to resignations.

While a student is at work he is subject to all the rules and regulations imposed by his employer upon the other employees. All existing labor laws and conditions, including those pertaining to liability for accident, apply to the student in the same way as to any other employee.

In order to operate a co-operative course, the college must be located in or near an industrial center and, while there are over six hundred colleges and universities in the United States, yet comparatively few of them are so located that such a course is practicable. Akron is essentially a manufacturing center, and the President and Directors of the Municipal University of Akron selected this type of vocational education as being the latest and the one best adapted to the city's needs; therefore no other courses in Engineering and Commerce will be offered.

INDUSTRIAL ENGINEERING

A co-operative course is provided for the student who wants to take up the business side of engineering activity. It comprises the essentials of engineering and a thorough course in business training. The work covers five years and leads to the degree of Industrial Engineer. This plan takes the place of the so-called Manufacturing Production course.

COMMERCE AND ADMINISTRATION

For those desiring a commercial training, with practical work in factories, offices, and stores, a new co-operative course begins September, 1923. This course extends over five years, including summer work. It is operated on the alternate period basis for the first two years. During the last three years the students work afternoons and Saturdays. The degree of Bachelor of Science in Commerce and Administration will be given upon completion of the course. A thesis is required.

The full time Commerce and Administration and Secretarial Courses will be discontinued. Students now taking such courses will be permitted to complete them.

OUTSIDE WORK

The Dean of the College of Engineering and Commerce and the employer so plan the work that the student gets a carefully graded training beginning with work requiring no skill or experience and ending with actual professional work.

The shop work and the University work are co-ordinated by technically trained men experienced in professional practice. Thruout the five years of University work they will give courses whose aim is twofold: First, they supplement the outside training by explaining the different operations, the sequence of work, the technicalities of the machines, and, in short, any part of the work which the student does not understand, and which the foreman has not time to explain. This shows the student the vast educational opportunities open to him in his outside work and makes him more useful to his employer. Secondly, these courses cover the field of factory organization and cost accounting, routing of work for efficient production, study of the conditions leading to maximum production, and the influence of shop environment. The instruction given in all the courses is carefully planned to develop in each student the power of observation and the ability to analyze the problems arising in his work.

The outside work, properly co-ordinated with the University training, furnishes a large part of the technical detail required in professional subjects.

WAGES

The primary object of requiring outside work is to give the student practical experience and not to enable him to earn money. In most cases the student's earnings are not sufficient to pay his expenses.

Engineering and Commerce students are paid for their outside work the same as other employees. Beginners are paid a little more than apprentices and are increased according to a rate agreed upon by the employer and the Dean of the College of Engineering and Commerce. Students are paid only for the time actually employed, and receive their wages direct, as does any other employee.

MILITARY TRAINING

Military training under the direct supervision of the United States Government is required of all male students physically fit. Men entering the College of Engineering and Commerce are exempt only if they have been two years in attendance at another institution of collegiate grade. It takes three years to complete the basic course on the co-operative or part-time plan, or two years and a basic camp. All freshmen are urged to take the basic camp at the end of the freshman year. Satisfactory arrangements have been made in the summer school for attendance at camp.

The advanced course is elective and is open to all who satisfactorily complete the basic course. The work of the Military Department is described in detail under the College of Liberal Arts, page 81.

ADMISSION

Candidates for admission must be at least sixteen years of age, and must present fifteen units of secondary school work. Students will be admitted with entrance conditions amounting to not more than one unit. Such conditions must be removed during the freshman year.

HONORABLE DISMISSAL

Engineering students desiring to transfer to another institution or to another college in the University of Akron are required to present a letter of honorable dismissal from the Dean of the College of Engineering and Commerce. To be entitled to such a letter, the student must notify the Dean's office and also his employer of his intention to leave, at least one week before he withdraws.

ENTRANCE REQUIREMENTS

The following units must be presented without conditions:

English	3	units
Mathematics	2½	units
Solid Geometry (for engineering students)	½	unit
Foreign Language	2	units
History	1	unit
Science	1	unit
Elective	5 or 5½	units

COURSES OF STUDY

The courses of study given in the College of Engineering and Commerce are of the same grade as those required in any recognized professional institution. The student is required to maintain good standing in both his outside and University work, and the work in both places is so planned that he will be equipped at graduation to enter practice at once without further preliminary training by his employer.

DEGREES

The degrees of Civil Engineer, Mechanical Engineer, Electrical Engineer, Industrial Engineer, and Bachelor of Science in Commerce and Administration will be given to those students who satisfactorily complete the required work. In addition to his diploma, each student will receive a certificate showing in detail his practical experience.

FEES

Resident Students:—According to the rules adopted by the Board of Directors, all students who are residents of the City of Akron, or whose parents are residents of Akron, are entitled to free tuition at the University. They are, however, required to pay a maintenance fee of $18.00 per semester, covering registration, incidentals, and student activity fee. If not paid within one week after registration, the fee is $20.50 per semester. Small fees to cover breakage and materials are also charged to all students in laboratory courses.

Non-resident Students:—The tuition for non-resident students is $60.00 for the first semester, $60.00 for the second semester, and $25.00 for the summer term, in addition to the maintenance fee of $18.00 per semester. If not paid within one week after registration the tuition is $65.00 each for the first and second semesters, the maintenance fee, $20.50, and the tuition for the summer term, $27.50.

The tuition for all students attending college full time is $90.00 per semester, in addition to the maintenance fee of $18.00 per semester. If not paid before October 10, of the first semester or March 13, of the second semester, the tuition fee is $95.00 per semester and the maintenance fee is $20.50.

LABORATORY FEES

The following fees are charged for courses in the College of Engineering and Commerce. By action of the Directors these laboratory fees are collectable strictly in advance and are a necessary prerequisite to enrollment in classes.

Deposit for breakage in all courses, per semester	$5.00
Chemistry 741, 742, per semester	3.00
Metallurgy 744, per semester	4.00
Elementary Mechanics, 781, 782, per semester	2.00
Physics 783, 784, per semester	2.00
Surveying 810, per semester	2.00
Materials Laboratory, per semester	2.00
Cement Laboratory, per semester	2.00
Mechanical Laboratory, per semester	3.00
Electrical Laboratory, per semester	3.00
Railroads, 853	1.00

The unused portion of the breakage deposit will be returned at the end of each semester.

ESTIMATED EXPENSE OF FRESHMAN YEAR

First Semester

	Resident	Non-Resident
Tuition	Free	$60.00
Fees	$27.00	27.00
Books and Drawing Instruments	40.00	40.00
	$67.00	$127.00

Second Semester

	Resident	Non-Resident
Tuition	Free	$60.00
Fees	$20.00	20.00
Books	8.00	8.00
	$28.00	$88.00

Summer Term

	Resident	Non-Resident
Tuition	Free	$25.00
Fees	$ 2.00	2.00
Books	5.00	5.00
	$7.00	$32.00

Board and room can be obtained for $10.00 per week.

REGISTRATION

Full time students will register on September 17 and 18, 1923. Co-operative students in section one will register on September 17, 1923, and those in section two on October 1, 1923. Students registering after these dates are charged an additional fee of one dollar for the first day and twenty-five cents per day for each succeeding day thereafter, but no one will be accepted later than five days after the last date set for registration.

After the student has classified, a charge of $1.00 will be made for any change in his program of studies.

CIVIL ENGINEERING

1923-1924

FRESHMAN YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	2	Physical Training	2
Mathematics 725	6	Mathematics 727	6
Mechanical Drawing 811	4	Mechanical Drawing 822	4
Elementary Mechanics 781	4	Elementary Mechanics 782	4
Engineering Laboratory 807	4	Engineering Laboratory 808	4
Co-ordination 801	2	Co-ordination 802	2

Summer Term

Mathematics 728	6
Surveying 810	16

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	2	Physical Training	2
Mathematics 729	6	Mathematics 730	6
Physics 783	6	Physics 784	6
Descriptive Geometry 812	4	Steam Power Plants 847	5
Co-ordination 803	2	Co-ordination 804	2

Summer Term

Mathematics 731	6
Railroads 853	10
Geology 772	6

PRE-JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Chemistry 741	8	Chemistry 742	8
English Composition 701	4	English Composition 702	4
D. C. Electricity 867	6	A. C. Electricity 868	6
D. C. Laboratory 869	4	A. C. Laboratory 870	4

Summer Term

Roofs and Bridges 851	6
Sanitation 771	16

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Economics 737	6	Economics 738	6
English Literature 711	2	English Literature 712	2
Strength of Materials 837	6	Analytic Mechanics 842	6
Materials Laboratory 817	4	Metallurgy 744	6
Hydraulics 849	4	Highways 855	4

Summer Term

Cement Testing 861	8
Reinforced Concrete 873	14

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Bookkeeping 1027½	6	Business Administration 1037½	6
Concrete Design 879	6	Steel Design 874	6
Sewerage 881	8	Water Supply 882	8
Engineering Design 883	2	Engineering Design 884	2

MECHANICAL ENGINEERING

1923-1924

FRESHMAN YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	2	Physical Training	2
Mathematics 725	6	Mathematics 727	6
Drawing 811	4	Drawing 822	4
Elementary Mechanics 781	4	Elementary Mechanics 782	4
Engineering Laboratory 807	4	Engineering Laboratory 808	4
Co-ordination 801	2	Co-ordination 802	2

Summer Term

Mathematics 728	6
Machine Drawing 823	16

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	2	Physical Training	2
Mathematics 729	6	Mathematics 730	6
Physics 783	6	Physics 784	6
Descriptive Geometry 812	4	Steam Power Plants 847	5
Co-ordination 803	2	Co-ordination 804	2

Summer Term

Mathematics 731	6
Steam Power Plants 848	16

PRE-JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Chemistry 741	8	Chemistry 742	8
Strength of Materials 837	6	Analytic Mechanics 842	6
Materials Laboratory 817	4	Mechanism 844	5
		Mechanism Drawing 846	2
Co-ordination 805	2	Co-ordination 806	2

Summer Term

Engineering Laboratory 858	6
Machine Design 845	16

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English Composition 701	4	English Composition 702	4
Thermodynamics 871	5	Thermodynamics 872	5
Machine Design 877	4	Metallurgy 744	6
D. C. Electricity 867	6	A. C. Electricity 868	6
D. C. Laboratory 869	4	A. C. Laboratory 870	4

Summer Term

Engineering Laboratory 859	6
Hygiene and Sanitation 771	16

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Economics 737	6	Economics 738	6
English Literature 711	2	English Literature 712	2
Hydraulics 849	4	Hydraulic Machinery 850	5
Steam Power Plant Design 875	5	Steam Power Plant Inspection 876	2
Mechanical Engineering Problems 878	6	Business Organization 1037½	4
		Thesis	6

ELECTRICAL ENGINEERING

1923-1924

FRESHMAN YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	2	Physical Training	2
Mathematics 725	6	Mathematics 727	6
Drawing 811	4	Drawing 822	4
Elementary Mechanics 781	4	Elementary Mechanics 782	4
Engineering Laboratory 807	4	Engineering Laboratory 808	4
Co-ordination 801	2	Co-ordination 802	2

Summer Term

Mathematics 728	6
Machine Drawing 823	16

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	2	Physical Training	2
Mathematics 729	6	Mathematics 730	6
Physics 783	6	Physics 784	6
Descriptive Geometry 812	4	Steam Power Plants 848	5
Co-ordination 803	2	Co-ordination 804	2

Summer Term

Mathematics 731	6
Hygiene and Sanitation 771	16

PRE-JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Chemistry 741	8	Chemistry 742	8
English Composition 701	4	English Composition 702	4
D. C. Electricity 867	6	A. C. Electricity 868	6
D. C. Laboratory 869	4	A. C. Laboratory 870	4

Summer Term

Advanced Electrical Theory 891	12
Advanced Electrical Laboratory 901	10

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Economics 737	6	Economics 738	6
English Literature 711	2	English Literature 712	2
Advanced Electrical Theory 893	3	Advanced Electrical Theory 894	3
Advanced Electrical Laboratory 903	2	Advanced Electrical Laboratory 904	2
Strength of Materials 837	6	Analytic Mechanics 842	6
Materials Laboratory 817	4	Metallurgy 744	6

Summer Term

Advanced Electrical Laboratory 905	6
Electric Power Plants 896	16

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Hydraulics 849	4	Hydraulics 850	4
Thermodynamics 871	5	Thermodynamics 872	5
Special Electrical Problems 899	4	Special Electrical Problems 900	6
Electric Power Transmission 895	3	Electric Railways 897	3
Bookkeeping 1027½	6	Business Organization 1037½	6

INDUSTRIAL ENGINEERING

1923-1924

FRESHMAN YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	2	Physical Training	2
Mathematics 725	6	Mathematics 727	6
Drawing 811	4	Drawing 822	4
Elementary Mechanics 781	4	Elementary Mechanics 782	4
Engineering Laboratory 807	4	Engineering Laboratory 808	4
Co-ordination 801	2	Co-ordination 802	2

Summer Term

Mathematics 728	6
Machine Drawing 824	16

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	2	Physical Training	2
English Composition 701	4	English Composition 702	4
Physics 783	6	Physics 784	6
Economics 737	6	Economics 738	6
Co-ordination 803	2	Co-ordination 804	2

Summer Term

Industrial and Commercial Geography 1019½	11
Economic Development of the United States 1021½	11

PRE-JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Chemistry 741	8	Chemistry 742	8
Bookkeeping and Accounting 1027½	6	Bookkeeping and Accounting 1027½	6
Money and Banking 1045½	6	Statistics 1047½	6

Summer Term

Railroads and Traffic Problems 1049½	22

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English Literature 711	2	English Literature 712	2
Modern Language	6	Modern Language	6
D. C. Electricity 867	6	A. C. Electricity 868	6
D. C. Laboratory 869	4	A. C. Laboratory 870	4
Industries and Resources of Akron 1057½	2	Industries and Resources of Akron 1058½	2

Summer Term

Markets, Domestic Commerce 1043½ 22

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Elementary Law 1039½	4	Business Law 1040½	6
Accounting Problems and Cost Accounting 1051½	6	Accounting Problems and Cost Accounting 1052½	6
Business and Industrial Problems 1055½	2	Business and Industrial Problems 1056½	2
Business Administration 1037½	6	Business Administration 1038½	6
Business Finance 1035½	6	Thesis	4
Thesis	4		

COMMERCE AND ADMINISTRATION (Co-operative)

1923-1924

FRESHMAN YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	2	Physical Training	2
Mathematics 725	6	Mathematics 727	6
Mechanical Drawing 811	4	Mechanical Drawing 822	4
Accounting Recitation 1027½	5	Accounting Recitation 1028½	5
Accounting Laboratory	1	Accounting Laboratory	1
Co-ordination 801	2	Co-ordination 802	2

Summer Term

Industrial and Commercial Geography 1019½ 11
Economic Development of the United States 1021 11

COMMERCE AND ADMINISTRATION (Full Time)

1923-1924

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
*Military Training	2	*Military Training	2
Physical Training	2	Physical Training	2
Bookkeeping and Accounting 1027	3	Bookkeeping and Accounting 1028	3
Economics 1059	3	Economics 1060	3
Modern Language	3	Modern Language	3
History or Government	3	History or Government	3
Industries and Resources of Akron 1057	2	Money and Banking 1045	2
Electives	2	Electives	2

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*For men only.

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English 65	3	English 66	3
Elementary Law 1039	3	Business Law 1040	3
Business Finance 1035	4	Railroad and Traffic Problems 1049	4
Psychology	3	Psychology	3
Electives	5	Statistics 1047	3
		Electives	5

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Government or Sociology	3	Government or Sociology	3
Accounting Problems and Cost Accounting 1051	2	Accounting Problems and Cost Accounting 1052	2
Foreign Commerce 1053	2	Business and Industrial Problems	2
Electives	6	Business Administration	3
Thesis	2	Thesis	2

SECRETARIAL COURSE (Full Time)

1923-1924

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
*Military Training	2	*Military Training	2
Physical Training	2	Physical Training	2
Bookkeeping and Accounting 1027	3	Bookkeeping and Accounting 1028	3
Economics 1059	3	Economics 1060	3
English	3	English	3
Spanish	4	Spanish	4

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English 65	3	English 66	3
History or Government	3	History or Government	3
Index and Filing 1031	3	Business Correspondence and Secretarial Practice 1033	3
Psychology	3	Psychology	3
Spanish	3	Spanish	3
Elective	3	Elective	3

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Business Finance 1035	3	Business Administration 1037	3
Office Practice 1041	3	Office Practice 1042	3
History or Government	3	History or Government	3
Sociology	3	Sociology	3
Thesis	2	Business Law 1040	3
Elective	4	Elective	4

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*For men only.

DEPARTMENTS OF INSTRUCTION

The general system of numbering and arrangement is according to the following order:

English	701-712
Spanish	713-716
Mathematics	725-736
Economics	737-740
Chemistry	741-770
Biology	771-779
Physics and Mechanics	780-790
Engineering Subjects	801-950
Commerce Subjects	1001-1099

ENGLISH

701. **English Composition.**

Study of correct and forceful thot arrangement in sentences, paragraphs, and long compositions. Strict insistence upon correctness in punctuation, spelling and grammar.

702. Continuation of Course 701 with study of exposition of technical subjects.

711. **Literature.**

The chief purpose of this course is to give the student such information and training as will enable him to know what good literature is and to read it with greater intelligence and keener delight. Much reading is required, and still more is recommended.

712. Continuation of 711.

SPANISH

713. **Spanish.**

Elementary Spanish Grammar and selected readers. As soon as practicable, the students will be given work of definite commercial value in translation and composition.

714. Continuation of 713.

715. Continuation of 714.

716. Continuation of 715.

MATHEMATICS

725. **College Algebra.**

A thorough review of elementary algebra, exponents, radicals, quadratics, simultaneous equations, progressions, ratio, proportion and variations, logarithms, binomial theorem, and solution of equations of higher degrees.

727. **Plane Trigonometry.**

The use of the protractor, tables, and slide rule in solving problems involving trigonometric functions; identities, radians; trigonometric equations; inverse functions; oblique triangles.

728. **Plane and Solid Analytic Geometry.**

The study of equations and their loci; transformation of co-ordinates; the straight line, circle, parabola, ellipse and hyperbola, higher plane curves, polar curves, empirical curves; rectangular and polar co-ordinates of space; special surfaces.

729. Continuation of 728.

730. **Calculus.**

The work includes theory of limits, differentiations, series, expansion of functions, indeterminate forms, maxima and minima of functions of one or more variables, partial derivatives, curvatures, tangents, and normals.

731. Continuation of 730. The work includes integration of standard forms, integration of rational fractions, integration by various devices, summations and definite integral, application to surfaces, and volumes of revolution.

732. Continuation of 731, including applications of the calculus to lengths of arcs, areas, volumes, moments of inertia, radius of gyration, and other problems of mechanics.

ECONOMICS

737. **Economics.**

A consideration of the fundamental concepts of economics; definition of terms, theory of value, production, consumption, distribution, etc.

738. Continuation of 737. A study of practical economic problems such as wages, interest, rent, currency, banking, taxation, trusts, tariff, and socialism.

CHEMISTRY

741. Chemistry.

A study of the newer theories of chemistry with special attention to their application to commercial problems.

742. Continuation of 741. During the last half of the semester each student is required to make, and test before the class, at least one salt of each metal.

This course is planned to develop originality in the student rather than to cover a large field. He is thrown upon his own resources as much as possible and taught how to attack a problem.

744. Metallurgy.

The general metallurgy of common metals with special emphasis on iron and steel.

A review of the properties of metals and ores and the principles underlying the present practice of metallurgy.

BIOLOGY

771. Hygiene and Sanitation.

A four weeks' intensive course.

Two hours of lecture or recitation, three hours of laboratory work, and two hours of assigned reading daily.

A rapid survey of the fundamental laws and principles of biology, followed by a more detailed study of selected problems in nutrition, personal hygiene, first aid, sanitation, and public health.

GEOLOGY

772. Engineering Geology.

A survey of the essential facts of dynamic, structural, and economic geology. The relation of geology to the engineer and his work is kept constantly in mind. The class room work is supplemented by an excellent collection of Ward's minerals, rocks, Coals, etc., and by several inspection trips. Text: Ries and Watson.

PHYSICS

781. **Elementary Mechanics.**

A short survey of the field of mechanics, and an intensive study of systems of parallel forces and simple machines. The student is given a working concept of the principle of moments and its application to engineering problems. Five exercises per week, two recitations and two laboratory periods. Required of all freshmen.

782. A continuation of 781 and discussion of non-parallel forces, force polygons, and solution of problems based on this principle. Study of simple frames and calculation of stresses and compression by graphical and analytical methods. Four exercises per week, two recitations and two laboratory periods. Required of all freshmen.

783. **General Physics.**

The work includes dynamics, work and energy, projectiles, mechanics of liquids and gases, the properties of matter and its internal forces, wave motion, general principles of sound and of heat, with necessary laboratory work. Five exercises per week, three recitations and two laboratory periods. Required of all sophomores.

784. Continuation of 783 covering sound and light, with some work in heat. Required of all sophomores.

ENGINEERING

801. **Co-ordination.**

The course covers the preparation by the student of reports on outside work with special reference to points of interest, and the selection and tabulation of observed or suggested data which will be valuable as reference during the student's college work and after he graduates.

Mechanical engineering students study brief texts on machine shop tools and methods, foundry practice, factory layouts and maintenance, and production.

Civils, electricals, and commerce students likewise study materials, tools, and specific projects pertaining to their respective fields.

802. Continuation of 801.
803. Continuation of 802.
804. Continuation of 803.
805. Continuation of 804.
806. Continuation of 805.

807. **Elementary Engineering Laboratory.**

The course is divided among the civil, electrical, and mechanical laboratories. Its purpose is to give the student a general knowledge of the character of the work in each department and better enable him to choose his particular field. The student is taught the proper form of laboratory reports and is required to perform simple laboratory exercises.

808. Continuation of 807.

810. **Surveying.**

The theory and use of the transit and level. The surveying of areas and computations of the same. Maps and profiles. Tests and adjustments of instruments. Topographic surveying. Stadia and plane table. Text: Tracy's Plane Surveying: Prerequisite, 807.

811. **Elementary Engineering Drawing.**

Freehand sketching, lettering and mechanical drawing. The solution of carefully graded problems with special emphasis on the fundamental requirements of a good drawing.

812. **Descriptive Geometry.**

A study of the science of graphic representation with problems on points, lines, planes, surfaces, and solids with practical applications.

817. **Materials Laboratory.**

Compressive, tensile, and torsion tests of steel. Computation of modulus of elasticity. Tests of wood, brick, rubber, riveted joints, beams, and columns. A 100,000 pounds Riehle Tension Machine and a 60,000 inch-pound Riehle Torsion Machine, with many attachments, are used for most of these tests. Prerequisite, 837.

822. **Projection Drawing.**

Graphic representation of solids. Isometric and oblique drawing. Standard details of bolts, nuts, screws, structural shapes, etc.

823. **Machine Drawing.**

The drawing of machine parts including both detail and assembly drawing. Technical sketching. Modern drafting room practice.

824. **Machine Drawing.**

A special course for Industrial Engineers similar to 823.

837. **Strength of Materials.**

Tensile, compressive, and shearing stresses; riveted joints; torsion. A study of moments and stresses in various beams and resulting deflections. Columns are investigated by various formulas. Text: Boyd. Prerequisites, Elementary Mechanics and Calculus.

842. **Analytic Mechanics.**

Statics: Composition and resolution of forces, study of center of gravity, friction, and moment of inertia.

Kinetics: Rectilinear and curvilinear motion, work and energy. Text: Poorman. Prerequisite, Elementary Mechanics, Calculus and Physics.

844. **Mechanism.**

A study of the various means of transmitting and modifying machine motions. The determination of the relative displacement, velocity, and acceleration of different machine parts.

845. **Machine Design.**

A study of the fundamental principles involved in the design and operation of machinery with problems in the design of riveted joints, keys and shafting, belting, chains and sprockets, gearing, bearings, couplings, and other machine parts.

846. **Mechanism Drawing.**

Graphic representation of common methods of transmitting and modifying motion by means of cams, links, and toothed wheels.

847. **Elementary Steam Power Plants.**

The course includes a study of boilers and engines from a descriptive standpoint. Its purpose is to familiarize the student with the various parts of a steam power plant and enable him to grasp the theory and design involved in succeeding courses.

848. Continuation of 847.

849. **Hydraulics.**

The course combines lecture and laboratory work and includes the demonstration of some of the fundamental hydraulic laws on which the theory and design of hydraulic machinery are based.

850. **Hydraulic Machinery.**

The course includes a study of the theory and design of impulse and reaction turbines, centrifugal pumps, and the auxiliary hydraulic apparatus used in hydro-power plants.

851. **Roofs and Bridges.**

Calculation of stresses in several types of roof trusses for dead, snow, and wind loads. Calculations are made analytically and checked by graphics.

Stresses are calculated for several bridge trusses under dead and live loads. Text: Merriman & Jacoby's Stresses.

853. **Railroads.**

An intensive course in railroad construction and surveying. Includes field and office work in simple compound, and spiral curves. Prerequisite, 810.

855. **Highways.**

Study and design of all hard surface roads as well as earth roads; a study of street design and city paving. Traffic is studied by means of a traffic census. Road materials are tested. Text: Baker.

858. **Advanced Engineering Laboratory.**

The course includes experiments demonstrating some of the laws applying to the thermodynamics of steam engines and turbines with special reference to thermal efficiency, Rankine efficiency, efficiency ratio, the influence of the condenser on steam consumption, etc.

859. Continuation of 858. The course includes the study of the design and theory of gasoline engines, gas engines, gas producers, and calorimeters. Experiments are conducted in the gas engineering laboratory to determine the fuel consumption of the various types of engines studied.

861. **Cement Testing.**

Theory and manufacture of cement; standard laboratory tests of cement, mortar, and concrete; experimental investigations. A trip to a cement plant is usually arranged where the actual manufacture of cement is studied.

867. **Direct Current Theory.**

Principles of electricity and magnetism, electric and magnetic circuits; direct current generators and motors; storage batteries; industrial applications of direct current machinery.

868. **Alternating Current Theory.**

Alternating electromotive force and current; resistance, inductance and capacity in alternating current circuits, graphical and analytical treatment; theory of alternating current generators, motors, instruments, and transformers; industrial applications of alternating current machinery.

869. **Direct Current Laboratory.**

This course includes some elementary exercises in electricity and magnetism and various practical tests on direct current machines, supplementing theoretical work given in 867.

870. **Alternating Current Laboratory.**

This course includes elementary experimental study of alternating current circuits, and various practical tests on alternating current machines supplementing theoretical work given in 868.

871. **Thermodynamics.**

The course is designed to present the principles of thermodynamics relating to heat engines. It deals primarily with the transformation of heat energy into mechanical energy.

872. Continuation of 871. It presents some of the advanced theory of thermodynamics, and applies it to steam engines, steam turbines, air engines, refrigerating plants, etc.

873. **Reinforced Concrete.**

Theory of reinforced concrete. Analysis of the stresses which take place in rectangular beams, T beams, and columns. Practice in designing simple floor systems and columns. A working knowledge of the principles of mechanics is necessary. Text: Taylor & Thompson.

874. **Steel Design.**

Theory of steel design, graphic and algebraic computation of stresses.

Design of steel structures including roof truss, plate girder bridge, and truss bridge, with detailed drawings of principal connections. Text: Kirkham.

875. **Steam Power Plant Design.**

The course includes the fundamental requisites for the design of steam power plants. It covers the proportioning of boilers, grates, furnaces, stacks, superheaters, economizers, heaters, and condensers for a plant of a given capacity.

876. **Steam Power Plant Inspection.**

The course is devoted to tours of inspection to various steam power plants in the vicinity. Each trip is devoted to the inspection and study of a definite part of the plant and the proportions are checked by methods studied.

877. **Machine Design.**

A continuation of Machine Design 845 in which the student makes a complete design of an assigned machine.

878. **Mechanical Engineering Problems.**

The course is devoted to the solution of practical problems assigned to individual students. These problems are varied and are selected to present to the student the general nature of the work he will meet upon entering the ranks of the engineering profession.

879. **Concrete Design.**

Practice in designing various kinds of concrete structures, such as beams and girders and flat slab floor systems, beam bridges and arch bridges, footings, retaining walls and chimneys. The course is a continuation of 873. Text: Taylor and Thompson.

881. **Sewerage.**

Part I. Sewer Design. After some class room study and discussion, each student is required to design a complete sewer system for some district in Akron, or for an adjoining town.

PART II. Sewage Disposal. This consists of a comparative study of the various types of sewage treatment plants and several plants are visited. Text: Folwell or Metcalf & Eddy. Prerequisite, Hydraulics.

882. **Water Supply.**

After a review of formulae, methods, and practice, each student is required to design a complete water system for a portion of Akron or a nearby town. An inspection trip to Akron Pumping Station and Treatment Plant at Kent is arranged once a year. Text: Folwell. Prerequisite, Hydraulics.

883. **Engineering Design.**

Special problems in design. This course gives the student an opportunity to do extra work along the particular line in which he wishes to specialize.

884. Continuation of 883.

891. **Advanced Electrical Theory.**

Continuation of course 868. More thorough study of the construction and operating characteristics of electrical machines and appliances. The course includes a large number of problems.

893. Continuation of 891.

894. Continuation of 893.

895. **Electric Power Transmission.**

Systems of transmission and distribution, general requirements, mechanical design, poles, towers, insulators, conductors, erection, control, and protection.

896. **Electric Power Plants.**

Typical electric power stations and sub-stations, station locations, general arrangement of prime-movers and auxiliary apparatus, selection of generating units, station wiring, switchboards and protective devices. The course also includes inspection trips to power plants and sub-stations in this vicinity.

897. **Electric Railways.**

Forces acting on a train, speed-time curves, energy requirements, motor capacity, systems of control, direct versus alternating current, electricity versus steam.

899. **Special Electrical Problems.**

Solution of special problems in electrical engineering; design of electrical machinery.

900. Continuation of 899.

901. **Advanced Electrical Laboratory.**

Continuation of 870.

903. Continuation of 901.

904. Continuation of 903.

905. Continuation of 894.

COMMERCE AND ADMINISTRATION

Industrial and Commercial Geography.

1019. Full time.

1019½. Half time.

Growth and factors of commerce and industry; study of the most important industries of the United States; physical features of the world in their relation to the development of commerce and industry; centers of great industry, transportation, communication; relation of government to industry and trade.

Economic Development of the United States.

1021. Full time.

1021½. Half time.

Development of colonial industry with a careful survey of the industrial history of England; early trade restrictions; availability of the resources of the United States and their developments; movement of trade and industry in the early history of the country as well as present movements; effect of trade and tariff on industry; labor movements and the development of the labor union; our modern industries and their development.

Bookkeeping and Accounting.

1027. Full time.

1027½. Half time.

Science of constructing systematic records of business transactions; study of the double entry bookkeeping; critical examination of the typical factors in capital and revenue accounts; development of forms used in business; forms and records used in different industrial enterprises; many illustrative problems used; partnership and corporation accounting completed. C. P. A. problems used.

1028. Continuation of 1027.

Industrial and Business Economics.

1029. Full time.

1029½. Half time.

A study of the laws of production, exchange, distribution, and consumption, combined with an analysis of the industrial actions of men as regards land, labor, capital, money, credit, rent, interest, wages, etc. Special emphasis laid on the industrial and business side of the economic organization of society.

Indexing and Filing.

1031. Full time.

1031½. Half time.

The modern business office, its filing cases and appliances; a more advanced course in filing for the big office; latest methods for short cuts in filing materials; visits to factories and lectures by practical men in charge of filing departments. Various systems for indexing; a practical course for those interested in this character of work.

Business Correspondence and Secretarial Practice.

1033. Full time.

1033½ Half time.

An advanced course in business letter writing; development of business forms necessary to modern business; the modern business letter and report from the business man's side; work of the secretary in making reports and schedules for the office; a practical course to meet the needs of modern business. Problems and visits to offices.

Business Finance.

1035. Full time.

1035½. Half time.

Relation of finance to business; the financial side of business administration; history and origin of financial transactions; introduction to banking practices; work of the banker; stocks and bonds; budgets and financial reports; financial standards, promotion, dividends, and reorganization.

Business Administration.

1037. Full time.

1037½. Half time.

Origin and history of industrial and mercantile establishments; principles or organization; distribution of functions and the control of business; factors accounting for the location of industries; scientific management, its development and effect on the business of the modern world; labor unions and their relation to capital; job analysis; mental tests; latest forms of welfare work.

Elementary Law.

1039. Full time.

1039½. Half time.

The fundamental principles of American jurisprudence; outline and elements of statutory and common law and equity.

Business Law.

1040. Full time.

1040½. Half time.

Introduction to the customs and laws of trade, business, and finance; detailed study of contracts, bills and notes, bailments, agency, partnership, personal and real property; a study of the common carrier, insurance deeds, mortgages, wills, etc. Many cases are studied to show the application of law to business. The case system is used.

Office Practice.

1041. Full time.

1041½. Half time.

A study of the problems that come up in the work of the secretary; laboratory work in the application of the work of an office; practical experience in the offices of the administrative officers of the University; students' work in outside offices of the various industries of the city.

1042. Continuation of 1041.

Markets, Domestic Commerce.

1043. Full time.

1043½. Half time.

Development of the early types of markets; early trade routes; fairs, location of colonial marketing centers; development of modern markets and the factors affecting their development; advertising and sales systems; cooperation, its development and importance; the middleman, his functions and problems; the retailer, the consumer, and modern problems of the buyer and seller.

Money and Banking.

1045. Full time.

1045½. Half time.

Form and function of currency and credit; state and Federal laws of banking; Federal reserve banking system and its relation to the monetary system of the United States; the Clearing House; a brief study of the banking systems of foreign countries and a comparison with the Federal Reserve System.

Statistics.

1047. Full time.

1047½. Half time.

Elementary principles of statistics as a means to scientific study and interpretation of the measurable phenomena of economic and social life. A study of characteristics of statistical methods; sources and collections of statistical data; errors and approximation; classification and frequency distribution; averages; index numbers; criteria of association, cause and effect.

Railroads and Traffic Problems.

1049. Full time.

1049½. Half time.

Economic significance of modern development, organization and combination of railway systems; the development of the means of transportation; railway growth and consolidation; problems of railway traffic and rate making; rate theories and practice, legislative control, inland and coastwise commerce of the United States; railway commissions and public control; Government ownership and its relation to the public.

Accounting Problems and Cost Accounting.

1051. Full time.

1051½. Half time.

An exposition of the utility and methods of cost accounts; the problems, elements, and units of cost of various types of business, sources of cost data; measurement of direct costs; methods of apportioning and distributing overhead expenses; organization of cost systems; presentation and utilization of cost data; studies and reports of cost accounting systems; study of practical problems in local businesses; C. P. A. Problems.

1052. Continuation of 1051.

Foreign Commerce.

1053. Full time.

1053½. Half time.

Development of early commerce and commercial nations; theory of international trade; volume and character of imports and exports; governmental regulation, consular service, commercial methods and regulations for trade; aids to the development of trade, position of the United States in the commercial world and our future needs.

Business and Industrial Problems.

1055. Full time.

1055½. Half time.

A study of economical and industrial problems of importance to the business man; the business cycle; the railway problem, nature and extent of regulation, rate making, government ownership; the problem of capitalistic monopoly; the study of population, economic insecurity, trade unions, social reform and legal institutions, taxation, and modern problems of business.

1056. Continuation of 1055.

Industries and Resources of Akron.

1057. Full time.

1057½. Half time.

A study of the city of Akron as an industrial and commercial center; its railroads and water communications; the rubber industry, the products manufactured and exported; clay product industry, products and possibilities of the industry; motor truck industry; machine shops; cereal and other important industries; visits to factories; reports on processes.

1058. Continuation of 1057.

Commercial Economics.

1059. Full time.

1059½. Half time.

Purpose and scope of economics, the three fundamental laws; consumption of wealth; value and the consumer, the producer and the trader. A study of the laws of production, exchange, distribution and the consumption of wealth, combined with an analysis of the industrial actions of men as regards land, capital, money, credit, rent, interest, wages, etc. Text-book, lectures and individual investigation.

1060. Continuation of 1058.

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THE MUNICIPAL UNIVERSITY of AKRON

AKRON, OHIO MAY, 1924

COLLEGE OF ENGINEERING AND COMMERCE

1924-1925

PUBLISHED BY
THE MUNICIPAL UNIVERSITY OF AKRON

1924-1925 CALENDAR

June 19	Entrance examinations
September 9, 10	Entrance examinations
September 15, Monday	Registration and classification, co-operative students—Section I
September 15 and 16	Registration and classification, Commerce (juniors and seniors)
September 16, Tuesday	Class work begins for co-operative students—Section I
September 17, Wednesday	Class work begins, Commerce (juniors and seniors)
October 6, Monday	Registration and classification, co-operative students—Section II
October 7, Tuesday	Class work begins for co-operative students—Section II
November 27, 28 and 29, Thursday, Friday and Saturday	Thanksgiving Recess
December 20, Saturday noon	Christmas vacation begins
January 5, Monday	Class work resumed
January 16, Friday	Founder's Day
January 23 and 24	Registration and classification for Commerce (juniors and seniors)
February 2, Monday	Registration, co-operative students —Section I
February 23, Monday	Registration, co-operative students —Section II
April 4, Saturday noon	Easter recess begins
April 13, Monday	Class work resumed
May 14, Thursday	Student elections
May 29, Friday	Tree Day
May 30, Saturday	Memorial Day—a holiday
June 15-17, Monday to Wednesday, inclusive	Commencement

FACULTY

PARKE R. KOLBE, Ph. D.
President of the University

FRED E. AYER, C. E.
Dean of the College of Engineering and Commerce

THOMAS L. MCJOYNT, LL. B., B. C. S.
Professor of Co-ordination

WALTER A. GILMOUR, B. S. in C. E.
Instructor in Co-ordination and Mechanics

ROSS C. DURST, C. E.
Professor of Civil Engineering

JOHN W. BULGER, B. C. E.
Instructor in Civil Engineering

FRED S. GRIFFIN, M. E.
Assistant Professor of Mechanical Engineering

FRANK D. CLARK, M. E.
Assistant Professor of Mechanical Engineering

JOHN T. WALTHER, B. S.
Professor of Electrical Engineering

ROBERT J. ANDERSON, B. S. in E. E.
Instructor in Electrical Engineering

LAWRENCE M. MCDERMOTT, A. M.
Professor of Commerce and Business Administration

DAVID MAX SHARER, A. B.
Instructor in Commerce and Business Administration

O. J. MARSH, A. B.
Instructor in Commerce and Business Administration

CLAUDE M. NEWLIN, A. M.
Instructor in English

HEZZELTON E. SIMMONS, M. S.
Buchtel Professor of Chemistry
Director of the Evening Session

FREDERICK S. SEFTON, B. S.
Director of the Department of Physical Education

SARAH E. DUNCKLEY, B. S.
Physical Instructor for Women

CHARLES BULGER, A. M.
Hilton Professor of Modern Languages

AMON B. PLOWMAN, Ph. D.
Professor of Biology

ELIZABETH A. THOMPSON, A. M.
Professor of History
Dean of Women

FRED F. HOUSEHOLDER, A. M.
Professor of Physics

WILLIAM L. TYDINGS, Captain, Infantry, U. S. A.
Professor of Military Science and Tactics

EARL W. CRECRAFT, Ph. D.
Professor of Political Science and Economics

JOHN L. JONES, Ph. D.
Ainsworth Professor of Mathematics

ERNEST F. SCHAEFER, B. E. M.
Instructor in Metallurgy
Director of the Bureau of City Tests

FRANCESCO B. DELEONE, Mus. D.
Director of Music

RENA B. FINDLEY
Librarian

COLLEGE OF ENGINEERING AND COMMERCE

FRED E. AYER, C. E., DEAN

GENERAL INFORMATION

The Directors of the Municipal University of Akron established the College of Engineering in 1914, and adopted the five-year co-operative course patterned after the ''Cincinnati Plan.''

In 1921 the Department of Commerce and Administration became a department of the Engineering College and the name of the latter was changed to the College of Engineering and Commerce. Business training students enrolled previous to 1923 will continue on full time; all other students must do outside work.

The ''Cincinnati Plan'' aims to give the student a thorough training in both theory and practice by requiring the practice to be learned under actual commercial conditions in local industrial and business organizations, and the underlying science to be studied in the University under trained educators. To accomplish this the students are grouped in two sections, one of which is at work and the other in attendance at the University. For example, A, who is in section one, attends classes at the University for two weeks while B, who is paired with A, and who is in section two, is at work. Then they change places, and B attends the University for two weeks while A is at work. Of course this necessitates the giving of all University work twice, once for each section.

Five years of eleven months each are required to complete the course, each student being allowed a vacation of one week at Christmas time, one week at Easter or during commencement week, and two weeks in the later part of the summer.

Candidates for admission are required to spend the summers preceding their entrances, at continuous work on a job provided by the University. This probationary period affords the student an opportunity to test his fitness and liking for the course, and demonstrates his ability to satisfy his employer.

While a student is at work he is subject to all the rules and regulations imposed by his employer upon the other employees. All existing labor laws and conditions, including those pertaining to liability for accident, apply to the student in the same way as to any other employee.

In order to operate a co-operative course, the college must be located in or near an industrial center and, while there are over six hundred colleges and universities in the United States, yet comparatively few of them are so located that such a course is practicable. Akron is essentially a manufacturing center, and the President and Directors of the Municipal University of Akron selected this type of vocational education as being the latest and the one best adapted to the city's needs; therefore no other courses in Engineering and Commerce are offered.

INDUSTRIAL ENGINEERING

This co-operative course, which was provided for those who wished to take up the business side of engineering activity, is discontinued. Students now enrolled in the course will be permitted to complete their work and graduate. The new co-operative commercial course seems to meet the needs of students desiring to enter this field. It is possible for students in the commercial course interested in engineering to elect some engineering courses.

OUTSIDE WORK

The Department of Co-ordination and the employer so plan the work that the student gets a carefully graded training beginning with work requiring no skill or experience and ending with actual professional work.

The outside work and courses of study are co-ordinated by technically trained men experienced in professional practice. Throughout the five years of University work they will give courses whose aim is two-fold. First, they supplement the outside training by explaining the different operations, the sequence of work, the technicalities of the machine, and, in short, any part of the work which the student does not understand, and which the foreman has not time to explain. This shows the student the vast educational opportunities open to him in his outside work and makes him more useful to his employer. Secondly, these courses cover the field of business, factory organization, and cost accounting, routing of work for efficient production, study of the conditions leading to maximum production, and the influence of work environment. The instruction given in all the courses is carefully planned to develop in each student the power of observation and the ability to analyze the problems arising in his work.

The outside work, properly co-ordinated with the University training, furnishes a large part of the technical detail required in professional subjects.

WAGES

The primary object of requiring outside work is to give the student practical experience and not to enable him to earn money. In most cases the student's earnings are not sufficient to pay his expenses.

Engineering and Commerce students are paid for their outside work the same as other employees. Beginners are paid a little more than apprentices and are increased according to a rate agreed upon by the employer and the Department of Co-ordination. Students are paid only for the time actually employed, and receive their wages direct, as does any other employee.

DEGREES

The degrees of Civil Engineer, Mechanical Engineer, Electrical Engineer, and Bachelor of Science in Commerce and Administration will be given to those students who satisfactorily complete the required work. In addition to his diploma, each student will receive a certificate showing in detail his practical experience.

MILITARY TRAINING

Military training under the direct supervision of the United States Government is required of all male students physically fit. Men entering the College of Engineering and Commerce are exempt only if they have been two years in attendance at another institution of collegiate grade. It takes three years to complete the basic course on the co-operative or part-time plan, or two years and a basic camp. All freshmen are urged to take the basic camp at the end of the freshman year. Satisfactory arrangements have been made in the summer school for attendance at camp.

The advanced course is elective and is open to all who satisfactorily complete the basic course. The work of the Military Department is described in detail under the College of Liberal Arts.

ADMISSION

Candidates for admission must be at least sixteen years of age, and must present fifteen units of secondary school work. Students will be admitted with entrance conditions amounting to not more than one unit. Such conditions must be removed during the freshman year.

Application blanks properly filled out and entrance credits must be submitted prior to July 1.

ENTRANCE REQUIREMENTS

The following units are required for admission:

English	3 units
Mathematics	2½ units
*Solid Geometry (engineering students)	½ unit
History	1 unit
Science	1 unit
*Foreign Language	2 units
Electives	5 or 5½ units

REGISTRATION

Full time students will register on September 15 and 16, 1924. Co-operative students in the first section will register on September 15, 1924, and those in the second section September 29, 1924.

Students registering or paying fees after these dates are charged an additional fee of one dollar for the first day and twenty-five cents per day for each succeeding day thereafter, but no one will be accepted later than five days after the last date set for registration.

The payment of all fees is a part of the registration and a prerequisite to entering any classes.

After the student has classified, a charge of $1.00 will be made for any change in his program of studies.

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*Students who enter with a condition in solid geometry must remove it by the end of the freshman year. Students who enter conditioned in foreign language must remove such conditions before graduation.

FEES

Resident Students: According to the rules adopted by the Board of Directors, all students who are residents of the City of Akron, or whose parents are residents of Akron, are entitled to free tuition at the University. They are, however, required to pay a maintenance fee of $23.00 for the first semester and for the second semester, $18.00 for old students, and $20.50 for new students, covering registration, incidentals, and student activity fee. Small fees to cover breakage and materials are also charged in laboratory courses.

Non-resident Students: The tuition for non-resident students is $60.00 for the first semester, $60.00 for the second semester, and $25.00 for the summer term, in addition to the maintenance fee as stated above.

The tuition for all students attending college full time is $90.00 per semester, in addition to the maintenance fee as stated above.

All fees are payable as a part of the registration and before entering any classes.

A graduation fee of $5.00 is charged to all graduates, and is payable one week before graduation.

LABORATORY FEES

The following fees are charged for courses in the College of Engineering and Commerce. By action of the Directors these laboratory fees are collectable strictly in advance and are a necessary prerequisite to enrollment in classes.

Deposit for breakage in all courses, per semester	$5.00
Chemistry 741, 742, per semester	3.00
Metallurgy 744, per semester	4.00
Physics 781-785, per semester	2.00
Surveying 810, per semester	2.00
Materials Laboratory, per semester	2.00
Cement Laboratory, per semester	2.00
Mechanical Laboratory, per semester	3.00
Electrical Laboratory, per semester	3.00
Railroads 853	1.00
Engineering Laboratory 807, per semester	3.00

The unused portion of the breakage deposit will be returned at the end of each semester.

ESTIMATED EXPENSE OF FRESHMAN YEAR

FIRST SEMESTER

	Resident	Non-Resident
Tuition	Free	$60.00
Fees	$29.50	29.50
Books and Drawing Instruments	40.00	40.00
	$69.50	$129.50

SECOND SEMESTER

	Resident	Non-Resident
Tuition	Free	$60.00
Fees	$22.50	22.50
Books	8.00	8.00
	$30.50	$90.50

SUMMER TERM

	Resident	Non-Resident
Tuition	Free	$25.00
Fees	$2.00	2.00
Books	5.00	5.00
	$7.00	$32.00

Board and room can be obtained for $10.00 per week.

CIVIL ENGINEERING

1924-1925

FRESHMAN YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	1	Physical Training	1
Mathematics 725	6	Mathematics 727	6
Drawing 811	4	Drawing 822	4
Physics 781	5	Physics 782	5
Engineering Laboratory 807	4	Engineering Laboratory 807	4
Co-ordination 801	1	Co-ordination 802	1

Summer Term

Mathematics 728	6
Surveying 810	16

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	1	Physical Training	1
Mathematics 729	6	Mathematics 730	6
Physics 783	6	Physics 784	6
Descriptive Geometry 812	4	Heat Engineering 847	5
Co-ordination 803	1	Co-ordination 804	1

Summer Term

Mathematics 731	6
Railroads 853	8
Roofs and Bridges 851	8

PRE-JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Chemistry 741	8	Chemistry 742	8
English Composition 701	4	English Composition 702	4
Physics 785	5	Strength of Materials 837	6
Roofs and Bridges 855	4	Materials Laboratory 817	4

Summer Term

Cement Testing 861	6
Reinforced Concrete 873	16

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English Literature 711	2	English Literature 712	2
Hydraulics 849	6	Highways 856	4
D. C. Electricity 867	6	A. C. Electricity 868	6
D. C. Laboratory 869	4	A. C. Laboratory 870	4
Concrete Design 879	6	Steel Design 874	6

Summer Term

Geology 772	6
Hygiene and Sanitation 771	16

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Bookkeeping & Accounting 1027½	6	Business Administration 1037½	6
Sewerage 881	8	Water Supply 882	8
Economics 737	6	Economics 738	6
Engineering Design 883	2	Engineering Design 884	2

MECHANICAL ENGINEERING

1924-1925

FRESHMAN YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	1	Physical Training	1
Mathematics 725	6	Mathematics 727	6
Drawing 811	4	Drawing 822	4
Physics 781	5	Physics 782	5
Engineering Laboratory 807	4	Engineering Laboratory 807	4
Co-ordination 801	1	Co-ordination 802	1

Summer Term

Mathematics 728	6
Machine Drawing 823	16

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	1	Physical Training	1
Mathematics 729	6	Mathematics 730	6
Physics 783	6	Physics 784	6
Descriptive Geometry 812	4	Heat Engineering 847	5
Co-ordination 803	1	Co-ordination 804	1

Summer Term

Mathematics 731	6
Mechanical Engineering 826	16

PRE-JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Chemistry 741	8	Chemistry 742	8
Physics 785	5	Strength of Materials 837	6
Mechanism 844	4	Materials Laboratory 817	4
Mechanism Drawing 846	2	Mechanical Engineering 828	2
Mechanical Engineering 827	2		

Summer Term

Chemistry of Combustion 743	6
Hygiene and Sanitation 771	16

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English Composition 701	4	English Composition 702	4
Metallurgy 744	6	Machine Design 845	6
D. C. Electricity 867	6	A. C. Electricity 868	6
D. C. Laboratory 869	4	A. C. Laboratory 870	4
Mechanical Engineering 829	4	Mechanical Engineering 830	4

Summer Term

Machine Design 877	12
Mechanical Engineering 831	10

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English Literature 711	2	English Literature 712	2
Economics 737	6	Economics 738	6
Bookkeeping & Accounting 1027½	6	Business Administration 1037½	6
Hydraulics 849	6	Thermodynamics 871	6
Mechanical Engineering 833	4	Mechanical Engineering 834	4

ELECTRICAL ENGINEERING

1924-1925

FRESHMAN YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	1	Physical Training	1
Mathematics 725	6	Mathematics 727	6
Drawing 811	4	Drawing 822	4
Physics 781	5	Physics 782	5
Engineering Laboratory 807	4	Engineering Laboratory 807	4
Co-ordination 801	1	Co-ordination 802	1

Summer Term

Mathematics 728	6
Machine Drawing 823	16

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	1	Physical Training	1
Mathematics 729	6	Mathematics 730	6
Physics 783	6	Physics 784	6
Descriptive Geometry 812	4	Heat Engineering 847	5
Co-ordination 803	1	Co-ordination 804	1

Summer Term

Mathematics 731	6
Hygiene and Sanitation 771	16

PRE-JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Chemistry 741	8	Chemistry 742	8
English Composition 701	4	English Composition 702	4
D. C. Electricity 867	6	A. C. Electricity 868	6
D. C. Laboratory 869	4	A. C. Laboratory 870	4

Summer Term

Advanced Electrical Theory 891	10
Advanced Electrical Laboratory 901	6
Chemistry of Combustion 743	6

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Economics 737	6	Economics 738	6
Advanced Electrical Theory 893	4	Advanced Electrical Theory 894	4
Advanced Electrical Laboratory 903	2	Advanced Electrical Laboratory 904	4
Physics 785	5	Strength of Materials 837	6
Metallurgy 744	6	Materials Laboratory 817	4

Summer Term

Advanced Electrical Laboratory 905	6
Electric Power Plants 896	16

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Hydraulics 849	6	Thermodynamics 872	6
Special Electrical Problems 899	4	Special Electrical Problems 900	6
Electric Power Transmission 895	3	Electric Railways 897	3
Bookkeeping 1027½	6	Business Administration 1037½	6
English Literature 711	2	English Literature 712	2

INDUSTRIAL ENGINEERING

1924-1925

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Physical Training	1	Physical Training	1
English Composition 701	4	English Composition 702	4
Physics 783	6	Physics 784	6
Economics 737	6	Economics 738	6
Co-ordination 803	1	Co-ordination 804	1

Summer Term

Industrial and Commercial Geography 1019½	11
Economic Development of the United States 1021½	11

PRE-JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Military Training	2	Military Training	2
Chemistry 741	8	Chemistry 742	8
Bookkeeping and Accounting 1027½	6	Bookkeeping and Accounting 1027½	6
Money and Banking 1045½	6	Statistics 1047½	6

Summer Term

Railroads and Traffic Problems 1049½	22

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English Literature 711	2	English Literature 712	2
D. C. Electricity 867	6	A. C. Electricity 868	6
D. C. Laboratory 869	4	A. C. Laboratory 870	4
Business and Industrial Problems 1055½	2	Business and Industrial Problems 1056½	2
Industries and Resources of Akron 1057½	2	Industries and Resources of Akron 1058½	2
Business Finance 1035½	3		

Summer Term

Markets, Domestic Commerce 1043½	22

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Elementary Law 1039½	4	Business Law 1040½	6
Accounting Problems and Cost Accounting 1051½	6	Accounting Problems and Cost Accounting 1052½	6
Business Administration 1037½	6	Business Administration 1038½	6
Thesis	4	Thesis	4

COMMERCE AND ADMINISTRATION (Co-operative)

1924-1925

FRESHMAN YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
*Military Training	2	Military Training	2
Physical Training	1	Physical Training	1
Mathematics 725	6	Mathematics 727	6
Drawing 811	4	Drawing 822	4
Accounting Recitation 1027½	5	Accounting Recitation 1028½	5
Accounting Laboratory	1	Accounting Laboratory	1
Co-ordination 801	1	Co-ordination 802	1

Summer Term

Industrial and Commercial Geography 1019½	11
Economic Development of the United States 1021	11

SOPHOMORE YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
*Military Training	2	Military Training	2
Physical Training	1	Physical Training	1
Economics 737	6	Economics 738	6
Modern Language 713	6	Modern Language 714	6
English Composition 701	6	English 702	6
Co-ordination 803	1	Co-ordination 804	1

Summer Term

Railroads and Traffic Problems 1049½	22

COMMERCE AND ADMINISTRATION (Full Time)

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English 65	3	English 66	3
Elementary Law 1039	3	Business Law 1040	3
Business Finance 1035	3	Railroad and Traffic Problems 1049	3
Psychology	3	Psychology	3
Electives	5	Statistics 1047	3
		Electives	3

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Government or Sociology	3	Government or Sociology	3
Accounting Problems and Cost Accounting 1051	2	Accounting Problems and Cost Accounting 1052	2
Foreign Commerce 1053	2	Business and Industrial Problems	2
Markets, Domestic Commerce 1043	3	Business Administration	3
Electives	3	Thesis	2
Thesis	2		

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*For Men only.

SECRETARIAL COURSE (Full Time)

1924-1925

JUNIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
English 65	3	English 66	3
History or Government	3	History or Government	3
Index and Filing 1031	3	Business Correspondence and Secretarial Practice 1033	3
Psychology	3	Psychology	3
Spanish	3	Spanish	3
Elective	3	Elective	3

SENIOR YEAR

First Semester	Cr. Hrs.	Second Semester	Cr. Hrs.
Business Finance 1035	3	Business Administration 1037	3
Office Practice 1041	3	Office Practice 1042	3
History or Government	3	History or Government	3
Sociology	3	Sociology	3
Thesis	2	Business Law 1040	3
Elective	4	Thesis	2
		Elective	2

DEPARTMENTS OF INSTRUCTION

The general system of numbering and arrangement is according to the following order:

English	701-712
Spanish	713-716
Mathematics	725-736
Economics	737-740
Chemistry	741-770
Biology	771
Geology	772-779
Physics	780-790
Engineering Subjects	801-950
Commerce Subjects	1001-1099

ENGLISH

701. **English Composition.**

Study of correct and forceful thought arrangement in sentences, paragraphs, and long compositions. Strict insistence upon correctness in punctuation, spelling and grammar.

702. Continuation of Course 701 with study of exposition of technical subjects.

711. **Literature.**

The chief purpose of this course is to give the student such information and training as will enable him to know what good literature is and to read it with greater intelligence and keener delight. Much reading is required, and still more is recommended.

712. Continuation of 711.

SPANISH

713. **Spanish.**

Elementary Spanish Grammar and selected readers. As soon as practicable, the students will be given work of definite commercial value in translation and composition.

714. Continuation of 713.

715. Continuation of 714.

716. Continuation of 715.

MATHEMATICS

725. **College Algebra.**

A thorough review of elementary algebra, exponents, radicals, quadratics, simultaneous equations, progressions, ratio, proportion and variations, logarithms, binomial theorem, and solution of equations of higher degrees.

727. **Plane Trigonometry.**

The use of the protractor, tables, and slide rule in solving problems involving trigonometric functions; identities; radians; trigonometric equations; inverse functions; oblique triangles.

728. **Plane and Solid Analytic Geometry.**

The study of equations and their loci; transformation of co-ordinates; the straight line, circle, parabola, ellipse and hyperbola, higher plane curves, polar curves, empirical curves; rectangular and polar co-ordinates of space; special surfaces.

729. Continuation of 728.

730. **Calculus.**

The work includes theory of limits, differentiations, series, expansion of functions, indeterminate forms, maxima and minima of functions of one or more variables, partial derivatives, curvatures, tangents, and normals.

731. Continuation of 730. The work includes integration of standard forms, integration of rational fractions, integration by various devices, summations and definite integral, application to surfaces, and volumes of revolution.

ECONOMICS

737. **Economics.**

A consideration of the fundamental concepts of economics; definition of terms, theory of value, production, consumption, distribution, etc.

738. Continuation of 737. A study of practical economic problems such as wages, interest, rent, banking, taxation, trusts, tariff, and socialism.

CHEMISTRY

741. **Chemistry.**

A study of the newer theories of chemistry with special attention to their application to commercial problems.

742. Continuation of 741. During the last half of the semester each student is required to make, and test before the class, at least one salt of each metal.

This course is planned to develop originality in the student rather than to cover a large field. He is thrown upon his own resources as much as possible and taught how to attack a problem.

743. **Chemistry of Combustion.**

A study of the various solid, liquid, and gaseous fuels by the methods of proximate and ultimate analysis of their constituents, and calorimetric tests of their heating values. The analysis of flue-gas and gaseous fuels, and the chemical effects of improper air supply, are included.

744. **Metallurgy.**

The general metallurgy of common metals with special emphasis on iron and steel.

A review of the properties of metals and ores and the principles underlying the present practice of metallurgy.

BIOLOGY

771. **Hygiene and Sanitation.**

A four weeks' intensive course.

Two hours of lecture or recitation, three hours of laboratory work, and two hours of assigned reading daily.

A rapid survey of the fundamental laws and principles of biology, followed by a more detailed study of selected problems in nutrition, personal hygiene, first aid, sanitation, and public health.

GEOLOGY

772. **Engineering Geology.**

A survey of the essential facts of dynamic, structural, and economic geology. The relation of geology to the engineer and his work is kept constantly in mind. The class room work is supplemented by an excellent collection of Ward's minerals, rocks, coals, etc., and by several inspection trips. Text: Ries and Watson.

PHYSICS

These courses are arranged to cover the subject of mechanics and sound in the first two years, and heat and light during the first semester of the third year. Since each course is built upon the preceding course, it is imperative that they be taken in the order given in the catalog.

781. An elementary course in statics. The conditions under which equilibrium can be obtained with systems of collinear and parallel forces. The application of the principle of moments to simple machines and pier reactions is emphasized. Five exercises per week: three recitations and two laboratory periods.

782. A continuation of 781 and discussion of non-parallel forces, force polygons, and their application to mechanical devices. Study of simple frames and calculation of stresses and compressions by graphical, analytical, and experimental methods. Problems and devices involving non-current forces and the equilibrium polygon. Five exercises per week: three recitations and two laboratory periods.

783. An extension of 782 to study of active forces in overcoming friction and in doing work, also a consideration of energy, power, mass, inertia, density and specific gravity, structure of matter and statics of fluids. Statics will be followed by dynamics of translatory motion. Six exercises per week: four recitations and two laboratory periods.

784. A continuation of 783 including dynamics of rotatory motion, statics of elasticity, and the dynamics of elasticity, emphasizing wave motion and sound. Six exercises per week: four recitations and two laboratory periods.

785. A course covering fundamental principles of heat and light with special emphasis on their engineering application. This course cannot be taken before 784. Five exercises per week: three recitations and two laboratory periods.

ENGINEERING

801. **Co-ordination.**

The course covers the preparation by the student of reports on outside work with special reference to points of interest, and the selection and tabulation of observed or suggested data which will be valuable as reference during the student's college work and after he graduates.

802. Continuation of 801.

803. Continuation of 802.

804. Continuation of 803.

805. Continuation of 804.

806. Continuation of 805.

807. **Elementary Engineering Laboratory.**

This course furnishes an introduction to certain principles and methods of procedure in civil, mechanical, and electrical laboratory work which are of fundamental importance to every engineering student. It also better enables him to choose his particular field. He is taught to perform simple laboratory exercises and to report upon them accurately and in proper form. Simple slide-rule manipulation is taught at the outset and applied throughout the year. The year is divided into three parts and the students into three groups, each group spending one-third of the year in each of the three engineering laboratories, civil (807-C), mechanical (807-M), and electrical (807-E).

810. **Surveying.**

The theory and use of the transit and level. The surveying and computation of areas. Maps and profiles. Tests and adjustments of instruments. Topographic surveying. Observations on the sun and on Polaris. Stadia and plane table. Text: Tracy's Plane Surveying. Prerequisite, 807.

811. **Elementary Engineering Drawing.**

Freehand sketching, lettering and mechanical drawing. The solution of carefully graded problems with special emphasis on the fundamental requirements of a good drawing.

812. **Descriptive Geometry.**

A study of the science of graphic representation, with problems on points, lines, planes, surfaces, and solids with practical applications.

817. **Materials Laboratory.**

Compressive, tensile, and torsion tests of steel. Computation of modulus of elasticity. Tests of wood, brick, rubber, riveted joints, beams, and columns. A 100,000 pounds Riehle Tension Machine and a 60,000 inch-pound Riehle Torsion Machine, with many attachments, are used for most of these tests. Prerequisite, 837.

822. **Projection Drawing.**

Graphic representation of solids. Isometric and oblique drawing. Standard details of bolts, nuts, screws, structural shapes, etc.

823. **Machine Drawing.**

The drawing of machine parts including both detail and assembly drawing. Technical sketching. Modern drafting room practice.

824. **Machine Drawing.**

A special course for Industrial Engineers similar to 823.

826. **Mechanical Engineering.**

The major portion of the work dealing with the generation and use of mechanical power is conducted by the three upper classes simultaneously during a period of three years for each class, and in a manner closely resembling the activities of an engineering organization.

Particular effort is directed toward developing ability to think constructively and practically, the positions of highest responsibility being assigned on the basis of college seniority and proven ability. To a large extent, the planning and executive direction of the course is entrusted to these higher officials of the organization. The material objective is the development of a carefully coordinated series of engineering compilations which shall include up-to-date digests suitable for use as texts, each member of the organization being required to make himself familiar with the contents of each text after its completion and apply it to the solution of synthetic problems such as actually occur in engineering work. The organization provides trained assistance on commercial tests, graduating theses, and advanced research.

827. Continuation of 826.

828. Continuation of 827.

829. Continuation of 828.

830. Continuation of 829.

831. Continuation of 830.

832. Continuation of 831.

833. Continuation of 832.

834. Continuation of 833.

837. **Strength of Materials.**

Tensile, compressive, and shearing stresses; riveted joints; torsion. A study of moments and stresses in various beams and resulting deflections. Columns are investigated by various formulas. Text: Boyd. Prerequisites, Elementary Mechanics and Calculus.

844. **Mechanism.**

A study of the various means of transmitting and modifying machine motions. The determination of the relative displacement, velocity, and acceleration of different machine parts.

845. **Machine Design.**

A study of the fundamental principles involved in the design and operation of machinery with problems in the design of riveted joints, keys and shafting, belting, chains and sprockets, gearing, bearings, couplings, and other machine parts.

846. **Mechanism Drawing.**

Graphic representation of common methods of transmitting and modifying motion by means of cams, links, and toothed wheels.

847. **Elementary Heat Engineering.**

This course is primarily a study of steam boilers, engines, and other mechanical power units and accessories from a descriptive standpoint, for the purposes of general information and assistance in grasping the theory and design involved in succeeding courses. The course also affords a brief survey of the entire subject of heat in its application to engineering.

849. **Hydraulics.**

A study of some of the fundamental laws on which the theory and design of hydraulic constructions and machinery are based, with applications to reciprocating and centrifugal pumps, impulse and reaction turbines, etc. Special consideration is given to the mechanical features of hydro-electric installations.

851-855. **Roofs and Bridges.**

Calculation of stresses in several types of roof trusses for dead, snow, and wind loads. Calculations are made analytically and checked by graphics.

Stresses are calculated for several bridge trusses under dead and live loads. Text: Merriman & Jacoby's Stresses.

853. **Railroads.**

An intensive course in railroad construction and surveying. Includes field and office work in simple compound, and spiral curves. Prerequisite, 810.

856. **Highways.**

Study and design of all hard surface roads; also study of earth roads, street design, and city paving. Traffic is studied by means of a traffic census. Road materials are tested. Text: Agg's Roads and Pavements.

861. **Cement Testing.**

Theory and manufacture of cement; standard laboratory tests of cement, mortar, and concrete; experimental investigations. A trip is made to a cement plant where the actual manufacture of cement is studied.

867. **Direct Current Theory.**

Principles of electricity and magnetism, electric and magnetic circuits; direct current generators and motors; storage batteries; industrial applications of direct current machinery. Prerequisite, Engineering Laboratory 807.

868. **Alternating Current Theory.**

Alternating electromotive force and current; resistance, inductance and capacity in alternating current circuits, graphical and analytical treatment; theory of alternating current generators, motors, instruments, and transformers; industrial applications of alternating current machinery.

869. **Direct Current Laboratory.**

This course includes some elementary exercises in electricity and magnetism and various practical tests on direct current machines, supplementing theoretical work given in 867.

870. **Alternating Current Laboratory.**

This course includes elementary experimental study of alternating current circuits, and various practical tests on alternating current machines supplementing theoretical work given in 868.

871. **Thermodynamics.**

This course continues the study of the transformation of heat into mechanical energy touched upon in the course in Elementary Heat Engineering (847) and makes practical application of the thermodynamic laws to steam engines and turbines, internal combustion engines, steam boilers, and other power plant apparatus, refrigerating systems, etc.

873. **Reinforced Concrete.**

Theory of reinforced concrete. Analysis of the stresses which take place in rectangular beams, T beams, and columns. Practice in designing simple floor systems and columns. A working knowledge of the principles of mechanics is necessary. Text: Taylor & Thompson.

874. **Steel Design.**

Theory of steel design, graphic and algebraic computation of stresses.

Design of steel structures including roof truss, plate girder bridge, and truss bridge, with detailed drawings of principal connections. Text: Ketchum.

877. **Machine Design.**

A continuation of Machine Design 845 in which the student makes a complete design of an assigned machine.

879. **Concrete Design.**

Practice in designing various kinds of concrete structures, such as beams and girders and flat slab floor systems, beam bridges and arch bridges, footings, retaining walls and chimneys. The course is a continuation of 873. Text: Hool and Johnson.

881. **Sewerage.**

Part I. Sewer Design. After some class room study and discussion, each student is required to design a complete sewer system for some district in Akron, or for an adjoining town.

Part II. Sewage Disposal. This consists of a comparative study of the various types of sewage treatment plants and several plants are visited. Text: Metcalf & Eddy. Prerequisite, Hydraulics.

882. **Water Supply.**

After a review of formulae, methods, and practice, each student is required to design a complete water system for a portion of Akron or a nearby town. An inspection trip to Akron Pumping Station and Treatment Plant at Kent is arranged once a year. Text: Folwell. Prerequisite, Hydraulics.

883. **Engineering Design.**

Special problems in design. This course gives the student an opportunity to do extra work along the particular line in which he wishes to specialize.

884. Continuation of 883

891. **Advanced Electrical Theory.**

Continuation of course 868. More thorough study of the construction and operating characteristics of electrical machines and appliances. The course includes a large number of problems.

893. Continuation of 891.

894. Continuation of 893.

895. **Electric Power Transmission.**

Systems of transmission and distribution, general requirements, mechanical design, poles, towers, insulators, conductors, erection, control, and protection.

896. **Electric Power Plants.**

Typical electric power stations and sub-stations, station locations, general arrangement of prime-movers and auxiliary apparatus, selection of generating units, station wiring, switchboards and protective devices. The course also includes inspection trips to power plants and substations in this vicinity.

897. **Electric Railways.**

Forces acting on a train, speed-time curves, energy requirements, motor capacity, systems of control, direct versus alternating current, electricity versus steam.

899. **Special Electrical Problems.**

Solution of special problems in electrical engineering; design of electrical machinery.

900. Continuation of 899.

901. **Advanced Electrical Laboratory.**
Continuation of 870.

903. Continuation of 901.

904. Continuation of 903.

905. Continuation of 904.

COMMERCE AND ADMINISTRATION

Industrial and Commercial Geography.

1019. Full time.

1019½. Half time.

Growth and factors of commerce and industry; study of the most important industries of the United States; physical features of the world in their relation to the development of commerce and industry; centers of great industry, transportation, communication; relation of government to industry and trade.

Economic Development of the United States.

1021. Full time.

1021½. Half time.

Development of colonial industry with a careful survey of the industrial history of England; early trade restrictions; availability of the resources of the United States and their developments; movement of trade and industry in the early history of the country as well as present movements; effect of trade and tariff on industry; labor movements and the development of the labor union; our modern industries and their development.

Bookkeeping and Accounting.

1027. Full time.
1027½. Half time.

Science of constructing systematic records of business transactions; study of the double entry bookkeeping; critical examination of the typical factors in capital and revenue accounts; development of forms used in business; forms and records used in different industrial enterprises; many illustrative problems used; partnership and corporation accounting completed. C. P. A. problems used.

1028. Continuation of 1027.

Industrial and Business Economics.

1029. Full time.
1029½. Half time.

A study of the laws of production, exchange, distribution, and consumption, combined with an analysis of the industrial actions of men as regards land, labor, capital, money, credit, rent, interest, wages, etc. Special emphasis laid on the industrial and business side of the economic organization of society.

Indexing and Filing.

1031. Full time.
1031½. Half time.

The modern business office, its filing cases and appliances; a more advanced course in filing for the big office; latest methods for short cuts in filing materials; visits to factories and lectures by practical men in charge of filing departments. Various systems for indexing; a practical course for those interested in this character of work.

Business Correspondence and Secretarial Practice.

1033. Full time.
1033½. Half time.

An advanced course in business letter writing; development of business forms necessary to modern business; the modern business letter and report from the business man's side; work of the secretary in making reports and schedules for the office; a practical course to meet the needs of modern business. Problems and visits to offices.

Business Finance.

1035. Full time.

1035½. Half time.

Relation of finance to business; the financial side of business administration; history and origin of financial transactions; introduction to banking practices; work of the banker; stocks and bonds; budgets and financial reports; financial standards, promotion, dividends, and reorganization.

Business Administration.

1037. Full time.

1037½. Half time.

Origin and history of industrial and mercantile establishments; principles of organization; distribution of functions and the control of business; factors accounting for the location of industries; scientific management, its development and effect on the business of the modern world; labor unions and their relation to capital; job analysis; mental tests; latest forms of welfare work.

Elementary Law.

1039. Full time.

1039½. Half time.

The fundamental principles of American jurisprudence; outline and elements of statutory and common law and equity.

Business Law.

1040. Full time.

1040½. Half time.

Elementary principles of statistics as a means to scientific study and interpretation of the measurable phenomena of economic and social life. A study of characteritics of statistical methods; sources and collections of statistical data; errors and approximation; classification and frequency distribution; averages; index numbers; criteria of association, cause and effect.

Railroads and Traffic Problems.
1049. Full time.
1049½. Half time.

Economic significance of modern development, organization and combination of railway systems; the development of the means of transportation; railway growth and consolidation; problems of railway traffic and rate making; rate theories and practice, legislative control, inland and coastwise commerce of the United States; railway commissions and public control; Government ownership and its relation to the public.

Accounting Problems and Cost Accounting.
1051. Full time.
1051½. Half time.

An exposition of the utility and methods of cost accounts; the problems, elements, and units of cost of various types of business, sources of cost data; measurement of direct costs; methods of apportioning and distributing overhead expenses; organization of cost systems; presentation and utilization of cost data; studies and reports of cost accounting systems; study of practical problems in local businesses; C. P. A. Problems.
1052. Continuation of 1051.

Foreign Commerce.
1053. Full time.
1053½. Half time.

Development of early commerce and commercial nations; theory of international trade; volume and character of imports and exports; governmental regulation, consular service, commercial methods and regulations for trade; aids to the development of trade, position of the United States in the commercial world and our future needs.

Business and Industrial Problems.
1055. Full time.
1055½. Half time.

A study of economical and industrial problems of importance to the business man; the business cycle; the railway problem, nature and extent of regulation, rate making, government ownership; the problem of capitalistic monopoly; the study of population, economic insecurity, trade unions, social reform and legal institutions, taxation, and modern problems of business.

1056. Continuation of 1055.

Industries and Resources of Akron.

1057. Full time.

1057½. Half time.

A study of the city of Akron as an industrial and commercial center; its railroads and water communications; the rubber industry, the products manufactured and exported; clay product industry, products and possibilities of the industry; motor truck industry; machine shops; cereal and other important industries; visits to factories; reports on processes.

1058. Continuation of 1057.

Commercial Economics.

1059. Full time.

1059½. Half time.

Purpose and scope of economics, the three fundamental laws; consumption of wealth; value and the consumer, the producer and the trader. A study of the laws of production, exchange, distribution and the consumption of wealth, combined with an analysis of the industrial actions of men as regards land, capital, money, credit, rent, interest, wages, etc. Text-book, lectures and individual investigation.

1060. Continuation of 1058.